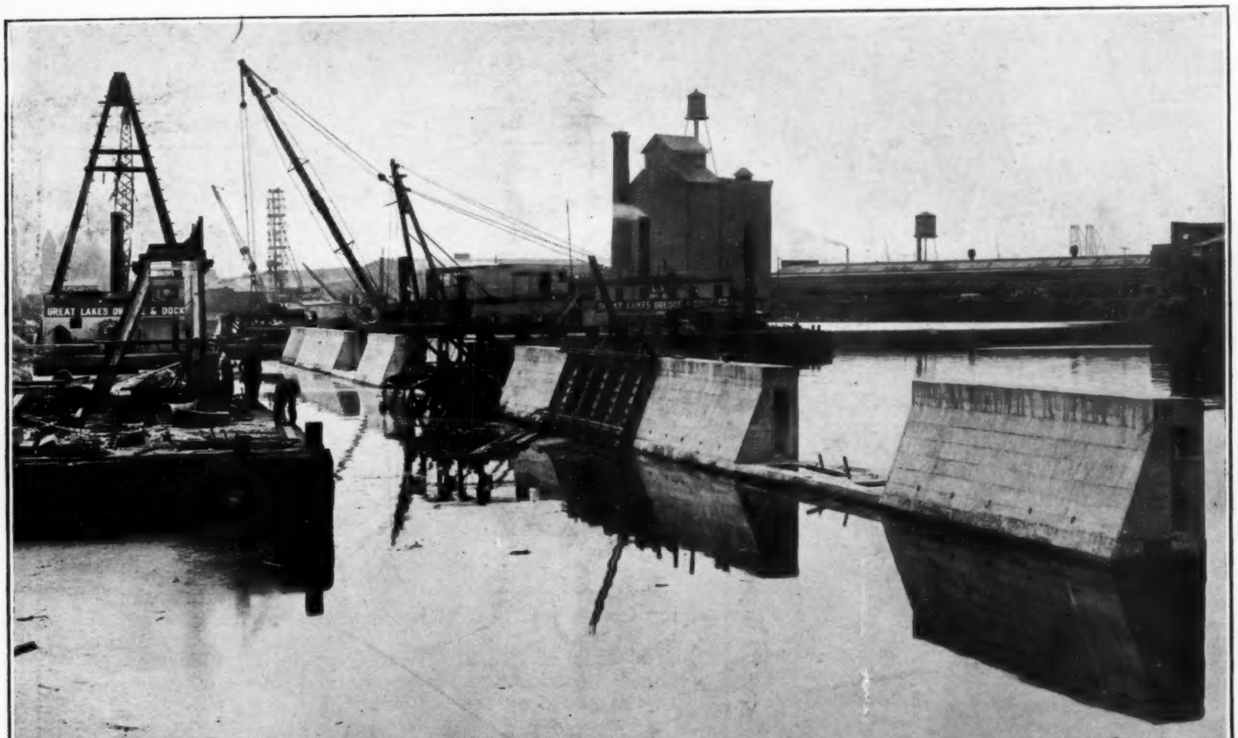
PUBLIC WORKS

CITY COUNTY STATE



COMPLETING OHIO BASIN DOCK WALL

Submerged forms in position for concreting two intermediate sections. Upper sections built in alternate units and form assembled for intermediate section in foreground

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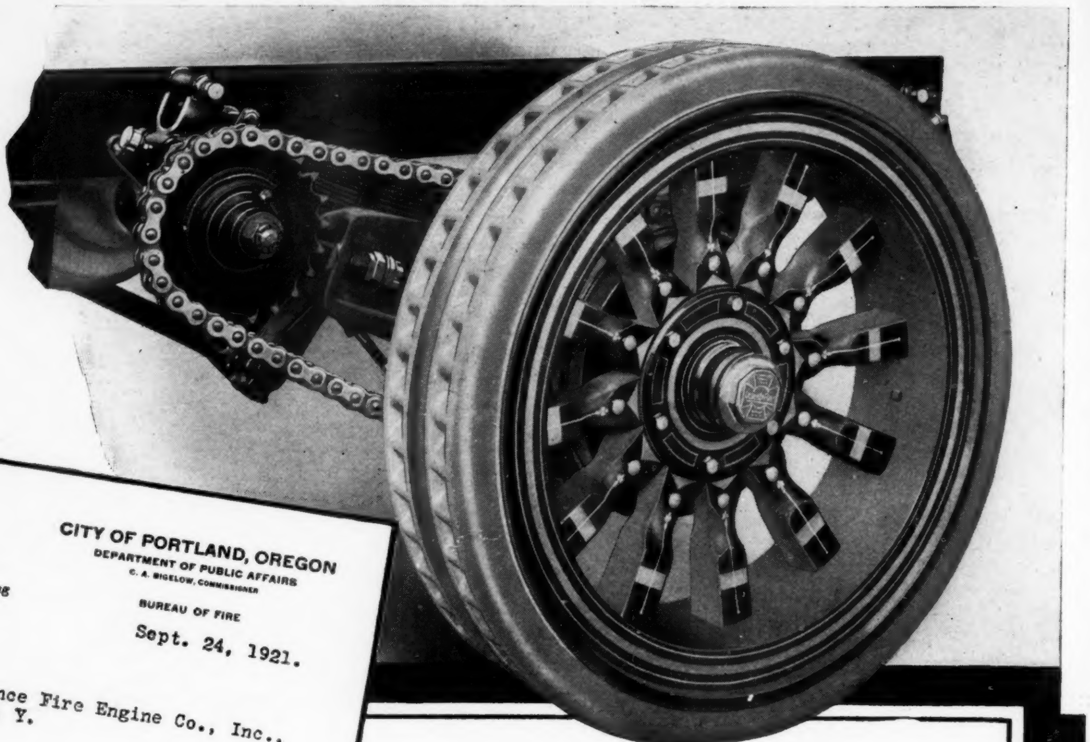

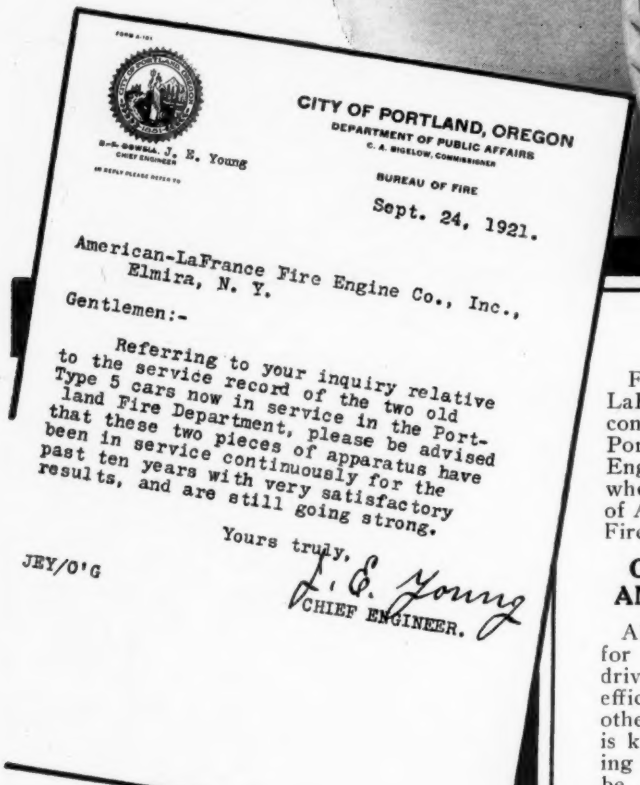

CITY OF PORTLAND, OREGON
DEPARTMENT OF PUBLIC AFFAIRS
C. A. BIGELOW, COMMISSIONER
BUREAU OF FIRE

J. E. Young
CHIEF ENGINEER

Sept. 24, 1921.

American-LaFrance Fire Engine Co., Inc.,
Elmira, N. Y.

Gentlemen:-

Referring to your inquiry relative to the service record of the two old Type 5 cars now in service in the Portland Fire Department, please be advised that these two pieces of apparatus have been in service continuously for the past ten years with very satisfactory results, and are still going strong.

Yours truly,
J. E. Young
CHIEF ENGINEER.

JEY/O'G

VOL. 52 NO. 13

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PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

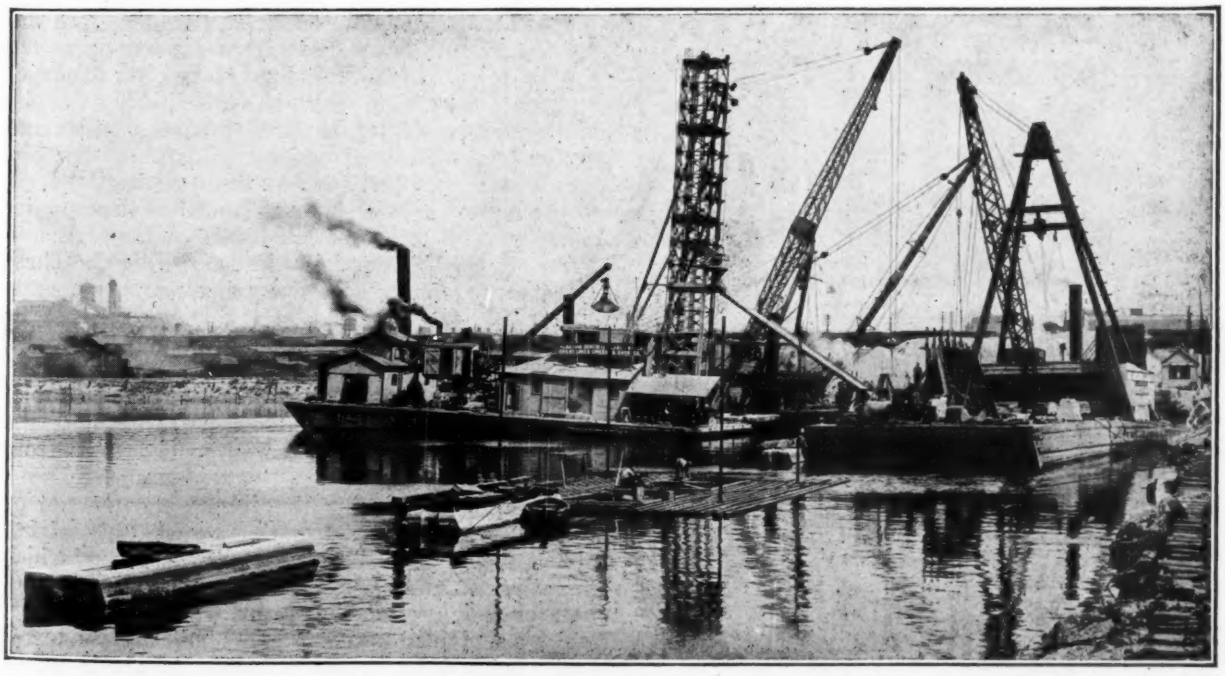
Vol. 52 April 1, 1922 NO. 13

Ohio Basin Dock Wall Construction at Buffalo

Cofferdams in water twenty-eight feet deep eliminated by use of submerged forms adjustable in gantry tower and shifted by derricks to make alternate sections of 1,460 feet of wall, 36 feet high, concreted in 25-foot lengths with bottom dump buckets filled by chutes from floating tower.

In 1920 a contract of about $435,000 was awarded to the Great Lakes Dredge & Dock Co. for the construction of 1,460 linear feet of concrete dock wall for the Ohio Basin at Buffalo, N. Y., of the New York State Barge Canal. The wall projects about 8 feet above the surface of the water where it has a thickness of 2 feet 6 inches and has a maximum height of about 36 feet and width of 18 feet, both faces being battered at the bottom and the outer face perpendicular on the upper part. It contains over 17,000 yards of concrete and had been about 60 per cent. completed when work was suspended last fall. It is expected that the work will be finished this year.

At the site the approximately horizontal surface of the bed rock is from 21 to 28 feet below the surface of the water and was covered with from 8 to 10 feet of sand, clay and earth. Under the original specifications the contractor was permitted the alternative of building the wall in the dry in a cofferdam as has been done with portions of the basin now being constructed under other contracts, or of



FLOATING DERRICKS, LIGHTERS, CONCRETE PLANT AND SUPPLY BARGES. SOUNDING RAFT IN FOREGROUND. BETWEEN TWO COMPLETED SECTIONS OF LOWER PART OF DOCK WALL.

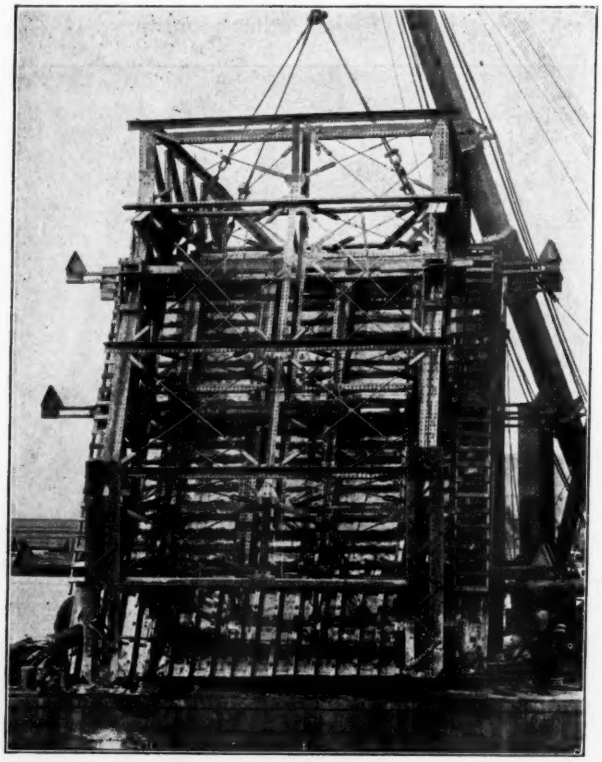
building it with concrete deposited under water up to within 12 feet of the surface of the water, above which it was to be deposited in the dry.

After the award of the contract the contractor's investigation led him to propose a new method of constructing the wall in 25-foot long sections built separately by depositing all the concrete up to water level in special submerged steel forms, which insured accuracy of alignment and dimensions and protected the fresh concrete from washing or segregation. This method was conceived and designed by F. C. Hibbard, manager of the Great Lakes Dredge & Dock Co., and W. P. Feeley, Buffalo, both experienced designers and constructors of marine and harbor improvements. This method was approved by Frank M. Williams, state engineer, whose cooperation made the execution of the work possible.

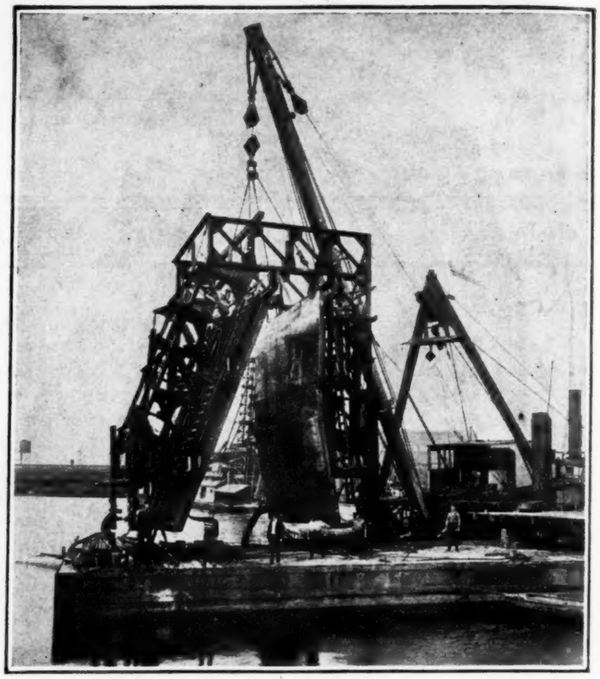
LARGE SUBMERGED ADJUSTABLE FORMS

A very important element of the equipment installed for the execution of the work was the two steel forms of unusually large dimensions, which were built by the Blaw-Knox Co. according to the contractor's general design, the details and working parts of the form being designed by the builders in accordance with their patents.

The forms for the front and rear face of the wall were 25 feet long and consisted substantially of flat steel lagging plates, countersunk riveted to the outside ribs of structural steel in transverse vertical planes 5 feet apart. The lower edges of the steel plates terminate about 5 feet above the bottom of the form and beyond this point the steel plates are replaced by wooden planks to provide for easy and accurate fitting over irregularities of the rock surface.



EXTERIOR FACE OF SUBMERGED FORM SHOWING WOODEN LAGGING AT BOTTOM.



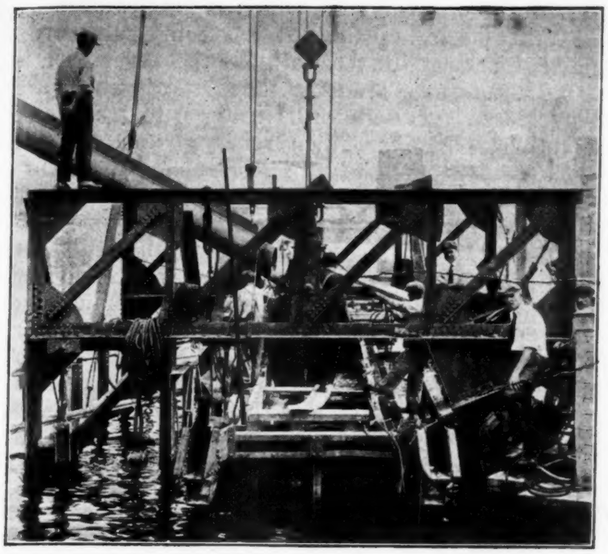
SIDE PIECES OF FORM SUSPENDED FROM TOWER, READY FOR SUBMERSION.

The two remaining sides or ends of the form are composed of vertical transverse detachable bulkheads that have horizontal wooden lagging nailed to vertical posts that engage top, bottom and intermediate outside riveted stiffening trusses in horizontal planes. The ends of the stiffening trusses project beyond the faces of the concrete walls and engage lugs riveted to the side forms, permitting them to be securely locked together to enclose wall sections from the rock bottom to the surface of the water.

The forms, weighing about 55 tons each, are suspended by turnbuckle rods from the top of a steel gantry tower with four legs resting on the rock bottom. The tower, which is made chiefly of angles and connection plates, has two transverse bents connected by longitudinal bracing. Each bent has two legs or side members, one of them vertical adjacent to the harbor side of the wall and the other one inclined parallel to the battered face of the wall, and both of them essentially lattice girders. These girders are connected by a transverse cap or top girder 19½ feet long and 5 feet 3 inches deep, under which there is clearance for the completed wall and a form between the side pieces.

The outer members of the side pieces have telescopic vertical bottom extensions to support the weight of the tower and the suspended form from the rock bottom.

The rods suspending the form from the top of the tower are pivoted to swing transversely, giving abundant lateral displacement for the forms, which are adjusted and securely braced in position by top, bottom and intermediate connections on each side, which are pivoted to toggle joints built into the tower and operated by screw adjustments above water level. By these devices the sides of the form can be accurately set in the exact required position and rigidly maintained there while the form is in service,



UPPER PART OF TOWER WITH FORM ADJUSTABLY SUSPENDED BELOW WATER LEVEL.

after which the adjustments can be slacked off, stripping the form from the concrete and providing clearance for its removal with the tower.

The tower is supported from the rock bottom at the four corners about 27 feet apart transversely and 18½ feet apart longitudinally, the vertical adjustments of the bearings being made by bolting the telescopic pieces in different positions or by the jackscrews for small displacements, or by a combination of both methods.

EXCAVATION AND PREPARATION

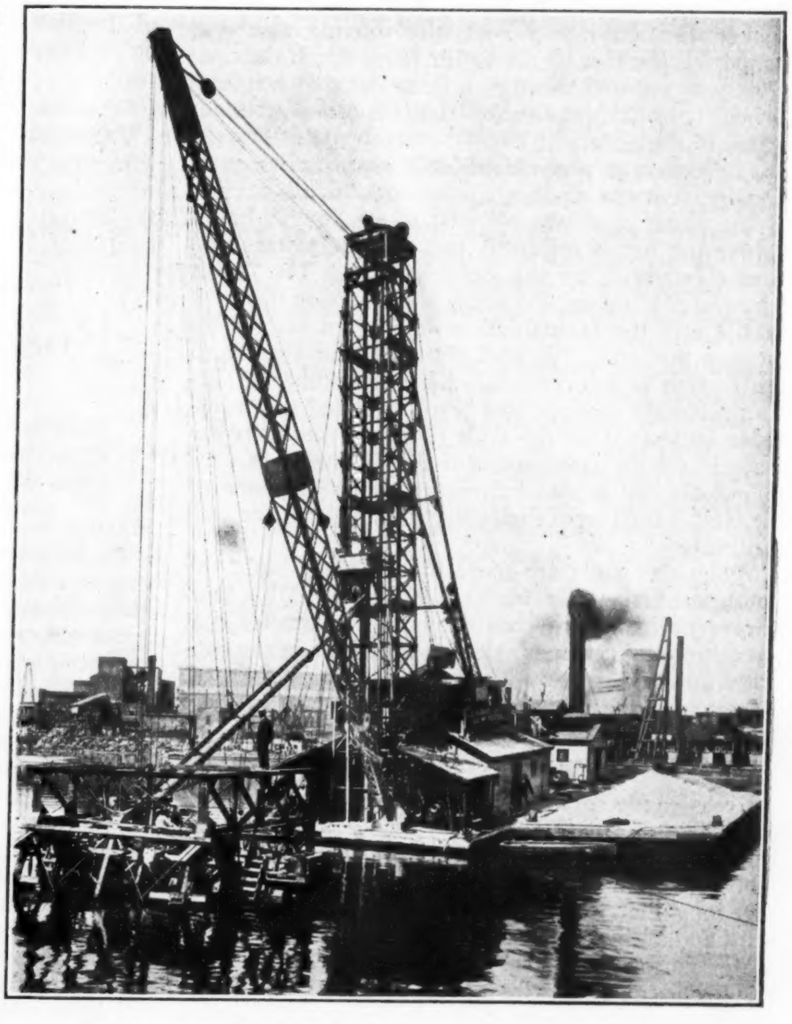
At the commencement of operations a trench about 30 feet wide and 10 feet in maximum depth was excavated in the lake bottom by a dipper dredge removing all the material that it could conveniently handle down to the surface of the rock.

The surface of the rock was then very carefully mapped and profiles constructed by means of soundings 6 inches apart on the front and back lines of the wall and across the ends of the section. The soundings were taken from a 60 x 30-foot raft having a framework of 12 x 12-inch longitudinal and intermediate cross timbers, floored with 6 x 6-inch transverse planks placed 6 inches apart in the clear, between which the soundings were taken with a wooden pole having a steel point. The raft was maintained in position by four 4-inch steel pipe spuds working in 5-inch vertical steel pipe guides, one at each corner of the raft, allowing the latter to rise and fall freely with the motion of the water. The raft was moored by four diagonal lines and was provided with a gage from which the varying elevations were recorded. Care was taken to moor the raft exactly in the required position, the soundings were corrected for the rise and fall of the water and were plotted to show the profile of the rock surface along the edges of the forms and these outlines were transferred full scale to the wooden planks forming the lower edge of the forms which were cut to fit the irregularities of the rock bottom, care being taken to cut them first for the deepest water, so that the successive positions of the form required only to have the planks trimmed a little more.

HANDLING AND ADJUSTING FORMS

The gantry tower was set up on the deck of a scow, the form suspended from it and properly connected and adjusted and the tower and form weighing together about 110,000 pounds, lifted by a pair of steel rope bridles attached to the 8-part hoisting tackle of the 75-ton floating derrick, which removed it from the scow and lowered it to position, maintaining it there until it was accurately centered and aligned and bearing on the rock bottom was effected by the adjustable vertical legs at the corners of the tower. Usually the assembling and placing of the form and gantry tower was accomplished by a gang of 20 men in 24 hours.

As soon as the form was in place a diver de-



FLOATING CONCRETE PLANT WITH HOISTING TOWER CHUTING CONCRETE FOR SUBMERGED FORM

scended in it and made a thorough examination of the rock bottom to insure the proper bearing at all points, fill any openings between the forms and the rock, and make necessary adjustments in the screw-jacks in the tower bearings. The diver also operated a hydraulic jet of 200 pounds pressure and 1½ inches nozzle diameter to loosen any earth or other material on the surface of the rock, which was immediately removed by the suction pipe of a 10-inch centrifugal pump.

CONCRETING

After the rock bottom had been inspected, satisfactorily cleaned and the form adjusted, the latter was filled with 1:2½:5 concrete made with Niagara river sand and gravel and having an extra bag of cement per cubic yard of concrete for all the under-water construction.

The concrete was mixed in a 1½-yard Lakewood machine installed on a scow that was moved up to position as soon as the form was ready. The concrete scow was served with sand and gravel delivered by supply scows alongside and handled by a clamshell bucket operated by the boom of the floating derrick and delivering into the charging hopper above the mixer. The concrete was delivered from the mixer to a bucket which was hoisted in a steel tower installed on the mixer boat. The hoisting bucket dumped into a vertically moving receiving hopper on the face of the tower from which the concrete was spouted through a steel chute to a special 2-yard bottom dump bucket that deposited it under water in the form.

The concrete was placed uniformly and continuously from the surface of the rock to the surface of the water, and was allowed to set for 48 hours before the forms were stripped and the towers and forms removed by the derrick boat. The lower edges of the forms were redressed to suit the rock profile and the forms and towers again set up for the new section of the wall 25 feet in the clear from the section last concreted. After a number of 25-foot alternate sections had been concreted the transverse bulkheads on the ends of the forms were removed and the side pieces of the forms were used to enclose the spaces between adjacent sections of the wall, which were then concreted, making the wall continuous.

When the walls are more than 20 feet high, the bottoms of the side forms are connected by temporary horizontal tie-rods 3 inches in diameter that pass through permanent sleeves imbedded in the concrete and are removed after the wall is finished. These rods are omitted in walls less than 20 feet high.

UPPER SECTIONS OF WALL

Recesses are cored in the upper surface of the wall to receive offsets in the construction joints between this part of the wall and the top portion about 8 feet high that is built in the dry in steel forms 25 feet long that weigh about 30,000 pounds each and are handled by the floating derricks. These above-water forms have steel lagging plates, countersunk riveted to exterior ribs about 5 feet apart in vertical transverse planes that are connected together above the top of the form to resist the interior pressure of wet concrete, which is also resisted by temporary horizontal ties in the bottom of the form.

The upper part of the wall, like the lower part, is made in alternate sections, the first of which are concreted in enclosed forms made with transverse bulkheads, which are then removed and the side forms used to enclose the intermediate spaces that are eventually concreted to make the walls continuous. The transverse construction joints between the successive sections of the wall, both above and below water level, are made with recesses and corresponding projections forming tongue and groove joints that bond them thoroughly together. The concrete in the upper part of the wall is proportioned 1:2½:5 and was placed at a maximum rate of 40 yards per hour. The work was so well planned and the organization so good that three 25-foot sections of the wall each containing about 275 yards of concrete were finished complete in six days.

QUALITY OF SUBMERGED CONCRETE

In order to verify the quality of the submerged concrete, manholes 2 feet in diameter were made in the first few sections of the wall that were concreted, extending from bottom to top. After the forms had been removed these manholes were pumped out and the concrete very carefully examined. This inspection showed the concrete to be of the first quality and so satisfactory that the manholes were discontinued in the later sections of the wall.

The total amount of concrete required is about 17,000 cubic yards and about 51,000 cubic yards of excavation has been made. The work has been executed with an average force of about 50 men, under the direction of R. W. Reed, superintendent for the contractor.

Road Work in 1921

Maximum mileage of state road construction—Some conclusions from the tests of the Illinois experimental road.

In a recent paper, Clifford Older, chief highway engineer of Illinois, claimed for that State that only Pennsylvania surpassed it in the mileage of high type pavements constructed last year, Pennsylvania having built 670 miles of modern high-type pavement and Illinois 412 miles; New York being next with 347 miles and Wisconsin having built 340 miles. Illinois hopes to build 1,000 miles of roads in 1922.

The director of highways of Ohio, L. C. Herrick, stated recently that Ohio leads in the nation's record of mileage of improved roads built in 1921, stating that more than 1,000 miles were constructed by Ohio, while the best previous record was 770 miles by Pennsylvania. Apparently Mr. Herrick's statement includes a considerable mileage of roads that would not come under Mr. Older's classificaiton of "modern high type." In Ohio a relatively small amount of uncompleted road building remains, and this year special attention will be given to maintenance work.

It is planned to construct something over 360 miles.

Illinois claims not only to lead all but Pennsylvania in high type construction, but takes to itself considerable credit for investigations made by means of the Bates experimental road, which was described in Public Works about a year ago. This road was started in 1920 and finished during the summer of 1921, and the test by running heavily loaded trucks over the road until it is tested to destruction began this week. Such research work as has been done to date has demonstrated several important facts, according to Mr. Older; among these, that the foundation soil under a pavement cannot be kept dry by means of tile drains, but that "tile drains are practically useless so far as keeping the foundation soil dry is concerned, although they may prevent excessive heaving of the slab because of frost action. The amount of water in the soil under a road slab may be as high as 40% of the weight of the dry soil, in spite of the fact that tile drains may be placed along each edge of the pavement."

Another point brought out by this test road was similar to that recently described in Public Works as having been determined at the Pittsburg, Cal., test road, namely, that pavement slabs curl up at the edges at night and rise off the foundation in the middle at daytime.

Mr. Older also stated that concrete slabs may be destroyed by repeated loading, owing to a fatigue of the slab. "A truck wheel carrying a load of 5 tons may pass along the edge of a 7-inch concrete pavement of the ordinary design once or twice without breaking the pavement; but if the same wheel passes along the edge from 10 to 50 times, the edge of the pavement breaks down in many places. Loads on such a pavement would have to be reduced to 2½ tons in order that trucks having wheel loads of this magnitude might be carried indefinitely by the pavement. However, investigations have shown that a pavement may carry loads equal to 60% or 70% of the critical loads only a few thousand times without breaking—in other words, in order to provide a reasonable factor of safety a pavement must not be loaded in excess of one-third of its apparent strength without danger of its failing in a comparatively short time."

Water Resources of New Jersey

Concise report on all resources available for supplying the metropolitan district comprising the northeastern quarter of the state. System needed comparable to New York's Catskill supply. Passaic Great Reservoir, Long Hill Reservoir, Raritan and other projects studied and compared.

A number of the communities in the northern part of New Jersey have in recent years endeavored to devise means or locate sources by which they might improve or enlarge their water supplies, but most of them without success. However, by state or co-operative action aimed to serve the entire Metropolitan district of that state as a unit, it seems possible to develop such abundant supplies of water that Allen Hazen, consulting engineer of New York, in a recent report is led to remark "the problem is to find a market for so much water."

In his report, a comprehensive one on the water requirements of the New Jersey Metropolitan district and the sources available for meeting them, submitted to the Board of Conservation and Development of New Jersey by Mr. Hazen, he has condensed into 70 pages possibly the most complete consideration of the water resources of northern New Jersey that has been made in recent years; and although none of the schemes proposed have been developed in their details, the relative advantages, both physical and financial, appear to have been determined with sufficient definiteness to permit the formulation of general plans of procedure for future development.

Mr. Hazen gives great credit to the New Jersey state maps showing topography, geology and forests, and the large scale maps covering a part of the area, which were used as a basis for his study of this problem. "If it had not been for these maps it would have been necessary to have made topographical surveys of the areas under consideration; our studies would have required years instead of months, and the cost of the field work, to arrive at anything like the point actually reached, might easily have exceeded the $60,000 reported as the original cost of the state survey."

Estimates of cost of this system are, of course, only approximations, since no detailed plans have been made nor even have borings been made at dam sites, along the routes of proposed tunnels, etc. However, the geology of the state has been pretty well worked out and these studies have been taken full advantage of in this investigation; while so many large dams, aqueducts and tunnels have been constructed recently in this section of the country that unit prices can be estimated with fair approximation.

The most expensive system in total cost, but the least expensive in cost per million gallons per day capacity, is estimated to have a total cost of $130,000,000 or $173,000 per m.g.d. capacity. This seems a large sum, but New York's Catskill supply had cost $150,000,000 up to December 31, 1921, and it is estimated that the development of the remainder of the Catskill supply will cost an additional $30,000,000. Moreover, this does not include filtration, as does the $130,000,000 for the New Jersey system, and if the cost of this be deducted we have the New Jersey system as costing $104,000,000 in comparison with $180,000,000 for the Catskill system. The capacities of the two are approximately the same and the chief reason for the difference in cost is that the length of tunnels and aqueducts in the Catskill sys-

tem from the Schoharie reservoir to the Ashokan reservoir, thence to Hill View reservoir, and thence to City Hall, New York, is about 127 miles, while the corresponding length of tunnels in the New Jersey system under consideration is only 52 miles. The population to be provided for is nearly as great, being estimated at 5,600,000 in the New Jersey Metropolitan district in 1970, for which it is estimated that 820 m.g.d. will be required.

Mr. Hazen first reviews briefly the thirty-three water supply systems which now supply the 2,070,000 people living in the six counties of the Metropolitan district. Two hundred and four m.g.d. supplied to these is surface water and 40 m.g.d. is ground water. A little over 50 per cent. of the population is supplied by privately owned plants, but these supply considerably less than half the water. The per capita consumption for the privately owned plants averages 99 gallons and for the publicly owned plants 139. Of the former, 77 per cent. of the services are metered, and 66 per cent. of those of the publicly owned plants.

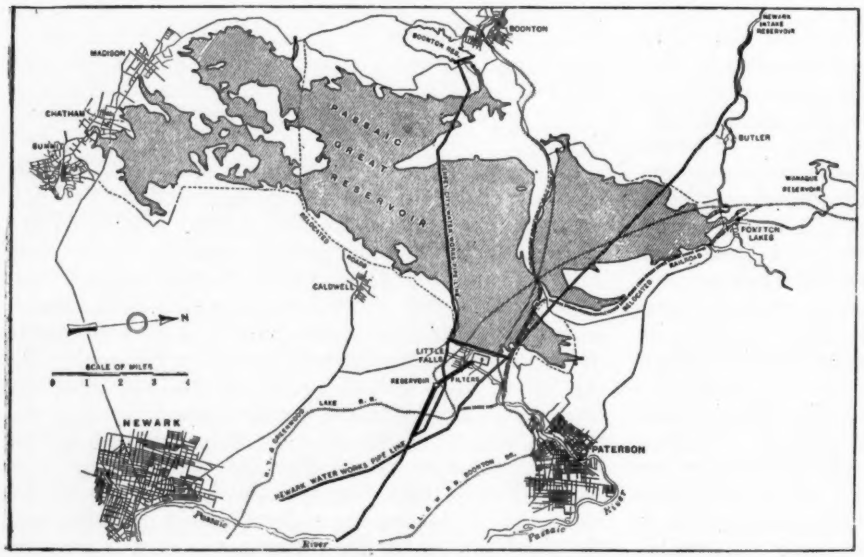
In order to show the effect of meters, Mr. Hazen has divided the systems into two classes, one in which 90 per cent. or more of the services are metered and the other in which less than 90 per cent. are metered, and finds that in the case of the former the average consumption is 89 gallons per capita and of the latter 154 gallons.

PRACTICABLE SOURCES OF SUPPLY

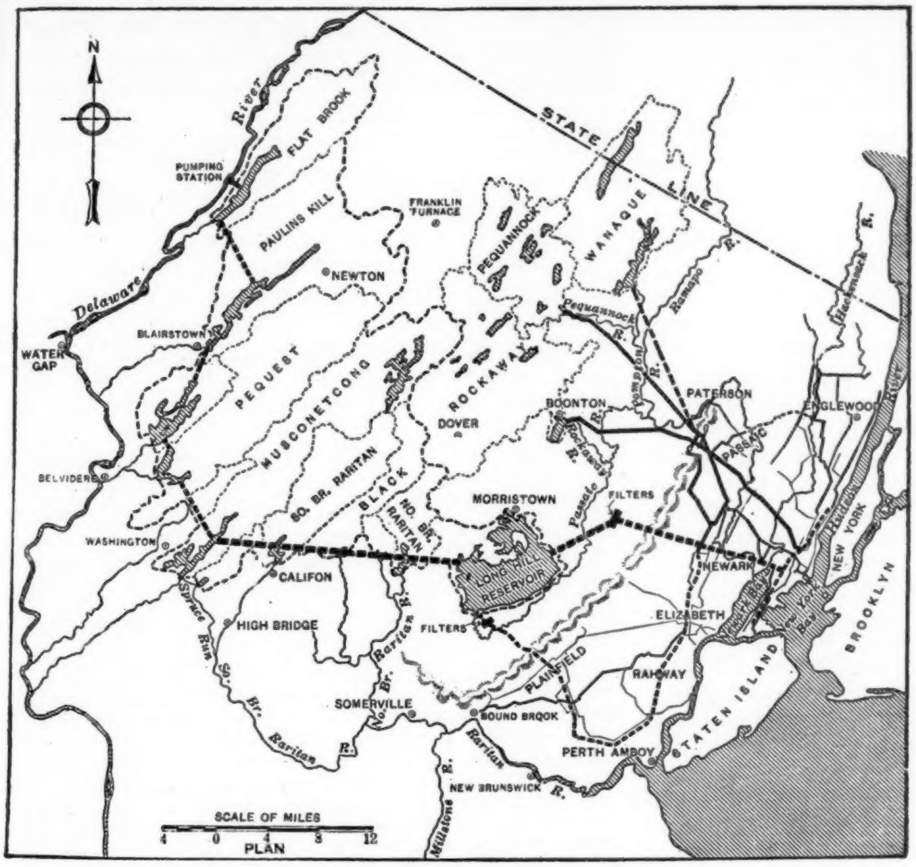
Passaic Great Reservoir:—A large part of the present supply for the district is drawn from the Passaic river and its tributaries, the largest being Newark's supply from the Pequannock, a tributary of the Passaic in the northern part of the state. One of the two sources of supply for the district which are considered most favorably by Mr. Hazen comprises the Passaic and all its tributaries above Little Falls. A dam would be built a short distance above Little Falls, which would create a reservoir called "Passaic Great Reservoir," which would extend 18 miles from north to south and would have an area of 61 square miles. One of the great advantages of this development would be that this reservoir would serve as an equalizing reservoir to prevent floods, such as the disastrous one of 1903. The chief disadvantage is the very large amount of land which must be purchased. It is not practicable to make the reservoir any smaller by constructing a lower dam, since a large part of the area to be flooded is practically level and any less height of dam would produce on thousands of acres shallower water than is considered desirable for a water works reservoir. It is estimated that the purchase of sites and payment of damages for this development would cost $39,000,000 out of the total estimated cost of $93,000,000. This reservoir would lie northwest of Newark, Jersey City and the other most thickly settled parts of the Metropolitan district, and could utilize the pipes and conduits now used for bringing supplies from this watershed, although these, of course, would have to be supplemented in the near future.

Long Hill Reservoir:—The only other supply which seems to Mr. Hazen to warrant serious consideration for potable purposes for the immediate future is that called Long Hill reservoir. As will be referred to later on, Mr. Hazen suggests the development of other supplies for manufacturing purposes solely. The Long Hill reservoir site is at the headwaters of the Passaic river west of Newark and Elizabeth and is formed naturally by a narrow ridge of trap rock eight miles long on one side, hills rising to considerable height on the other side of the valley, and a terminal moraine of ample proportion marking the northern limit of the reservoir. This moraine at its thinnest point is half a mile through at the level of the proposed water line and is a mile or more wide throughout most of its length. By building a dam on trap rock 110 feet high and 850 feet long, 24 square miles of this area would be flooded and a reservoir formed with a capacity of 328,000 million gallons, which is more than twice the size of the Ashokan reservoir and would be by far the largest water supply reservoir in the world.

The one unfortunate feature of the Long Hill reservoir is that there is little water immediately available for filling it. In order to remedy this it is proposed to tunnel under the hills lying immediately west and thus tap ten other main streams, which would furnish an abundance of water. In fact, the chain of tunnels and lakes feeding Long Hill reservoir could be extended entirely across the state to Flat Brook, which is only a mile from the Delaware River and 150 feet above it, and it would be possible to pump Delaware River water into the system either continuously or during that part of the year when the flow of the river is ample. The capacity of the storage reservoir would be such that practically the entire runoff of all the watersheds



PASSAIC GREAT RESERVOIR.



PLAN OF LONG HILL SYSTEM.

could be utilized. These sheds would be those of the northern branch of the Raritan, south branch of the Raritan, Musconetcong, Pequest, Beaver Brook, Paulinskill and Flat Brook. These would give a total catchment area of 645 square miles tributary to Long Hill reservoir.

The Long Hill reservoir would flood land on which are now found 781 dwelling houses, several grist mills, greenhouses, etc. About 40,000 people live on the entire catchment area, which population has not increased during the past 20 years. A small part of Morristown naturally drains toward the reservoir, but that city is already completely sewered, and the sewage is pumped to disposal works outside the catchment area.

The Long Hill reservoir would receive an ex-

PROFILE OF LONG HILL SYSTEM.

cellent character of water, although the precaution should be taken of filtering it and treating it with chlorine or other disinfectant, and the elevation, 320 feet above sea level, is such that the greater part of the area could be served by gravity. Moreover, it would require a tunnel only 19 miles long to bring the water to Newark and Jersey City and thus connect with the mains throughout the entire district.

Other Sources:—Two other sites were considered at some length, one of these a reservoir on the Raritan river a little west of the center of the state, the other an impounding of the Mullica and Wading rivers, about three-quarters of the way down the state, or southeast of Camden. The last named is too distant to consider unless other sources were unavailable, and in addition should probably be reserved for the needs of the southern part of the state. The Raritan project would cost a little more than the Passaic Great Reservoir, with less capacity, and would require considerably more pumping and longer aqueducts.

(To be continued)

$3,000,000 Memorial Bridge

Bill No. 10,243, now before the House of Representatives, calls for the Federal appropriation of $1,-500,000 towards the construction of a $3,000,000 bridge to carry the Lincoln Highway across the Susquehanna river in Lancaster county, Pennsylvania, connecting the boroughs of Columbia and Wrightsville and serving as a memorial to Abraham Lincoln and to General John F. Reynolds, who lost his life in the Civil War repelling the invasion which reached its northernmost point at the site of the bridge. The bill also calls for the provision of $25,-000 to secure a design and begin the construction of the bridge, which shall be used exclusively for foot passengers and vehicles.

Imhoff Tank Troubles

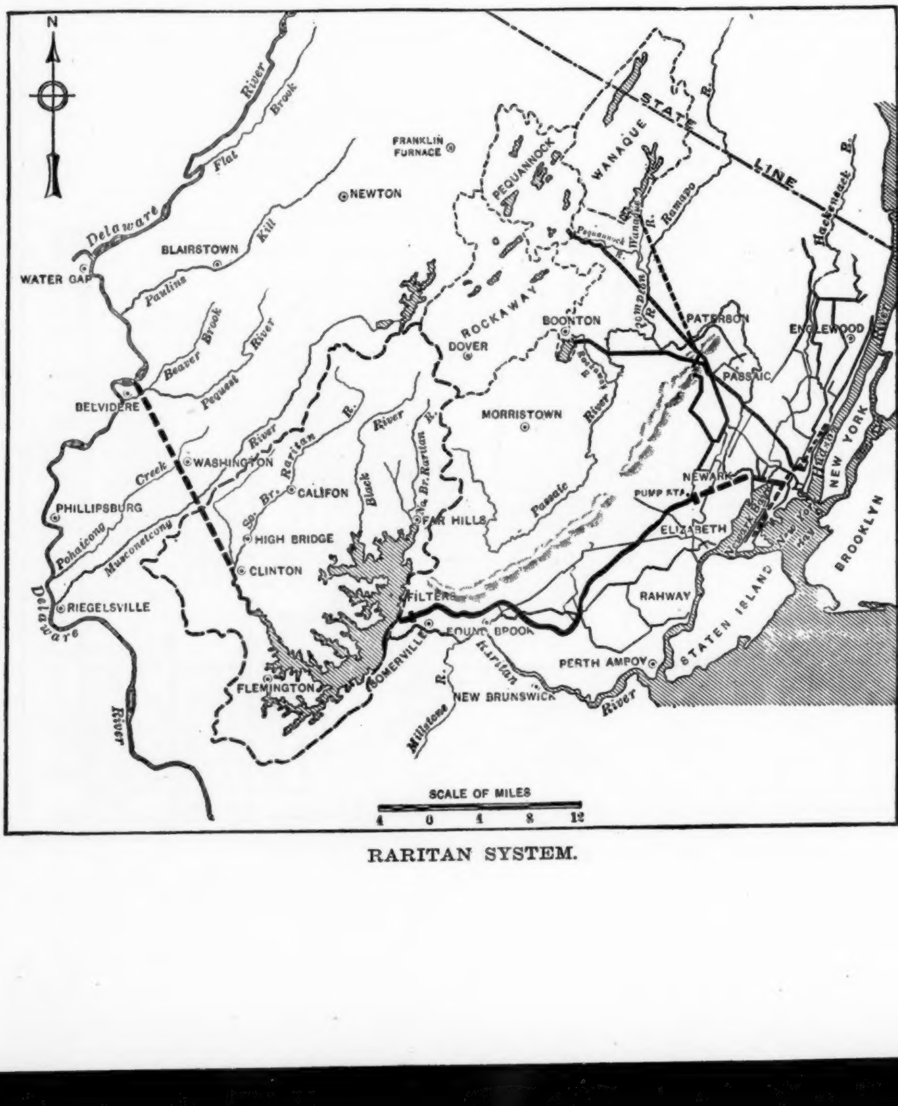
In connection with the articles on Imhoff tanks, recently published in PUBLIC WORKS, we have asked several engineers to comment on Mr. Riker's discussions of the subject, and among these is George T. Hammond, who has for a number of years been in charge of the sewage experimental plant of Brooklyn, N. Y., practices as consulting engineer on sewerage work, and is one of the leading engineers of the country on this subject.

Mr. Hammond writes us that he would prefer not to enter into any long discussion of this paper, feeling that he has sufficiently stated his opinion relative to tanks for treating sewage in his paper contributed to the symposium on "Stream Pollution and Sewage Disposal" before the American Society of Civil Engineers. He, however, makes the following comments:

Mr. Riker's paper has interested me greatly, but it is more concerned with presenting adverse data and stating difficulties encountered in New Jersey tank operation than it is with constructive criticism. If he is correct we shall all have to take to fine screens, I fear. He has certainly gathered and presented many disconcerting data for a tank man to explain. I am not sure, myself, that his conclusions are not correct, as they appear justified by his personal experience and observation, and I regard him very highly as an expert observer.

But I am unwilling to admit that his opinion is conclusive. I have seen many tanks operate without any trouble—and have operated some myself. Also I have seen many that gave trouble—and have had troubles myself with some. My own observations, however, tend at least to sustain the opinion that most of the troubles encountered are caused by poor design, or design not properly answering the local conditions, often because local conditions have not been correctly studied or interpreted—inadequate size, bad hydraulic and other faulty applications of principles—or rather failure to provide for the hydraulic requirements called for, etc., and finally, crass neglect after the tank is installed—or at best improper operation.

I do not believe that sanitary engineers are going to abandon the use of tanks in sewage treatment—tanks offer too many advantages. Mr. Riker has done us all a favor in pointing out many difficulties—all of which, I hope, will be overcome in time by constructive study. I hope he will now turn his attention toward solving some of these problems.



RARITAN SYSTEM.

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Highway Drains

Elsewhere in this issue, in an article giving abstracts from a paper by Clifford Older, chief highway engineer of Illinois, he is reported to have stated that the foundation soil under a pavement cannot be kept dry by means of tile drains, such drains being practically useless for this purpose. This apparently is given as a general statement, although based upon experiments made at the Bates experimental road by the Illinois highway department.

It is possible that Mr. Older did not intend this to be taken as a statement of general application, and it certainly should not be. In the heavy prairie soil on which the Bates road is laid, where there seems to be no possibility of draining the subsoil except by long ditches to distant depressions or streams, it is quite probable that tile drains under a pavement would have very little effect in drying out the ground. As a general statement, however, we think there is abundant proof in other localities that tile drains are of considerable use in keeping a subsoil dry where there is a point near at hand at which the water can rapidly flow away from the end of the drains. In other words, where the wetness of the subsoil is more or less localized and is not universal throughout the section through which the road passes, drains could be expected to do some good in the removal of subsoil water, the amount of benefit which they confer depending of course upon the wisdom with which the drainage system is designed and the natural possibilities of ground slope, drainage channels, etc.

It seemed to us desirable to make an explanation of this kind lest some young highway engineers might consider, from Mr. Older's statement, that it is no longer considered desirable to use drains under highway pavements.

Submerged Concrete Forms

Occasionally the application of a new method or process or the modification of old ones opens an important new field in construction. This is perhaps now the case in building submerged concrete walls and other substructures that are often very difficult and costly when executed by methods generally used heretofore.

Dock walls, piers, retaining walls, canal locks, foundations and other submerged substructures have generally been built in open or pneumatic caissons which are costly and slow; or with precast units that, when of large dimensions, require heavy plants for their transportation and handling and may involve difficulties and uncertainties in their foundations; or they are built in the dry in cofferdams which are likely to be very expensive to construct, maintain and unwater; or for very simple mass work the concrete has been deposited in submerged cribs, caissons, pits or trenches by the tremie method or by bottom-dump buckets, usually without complete protection or accurate dimensioning, and generally with some distrust of the quality and precision of the concrete.

These methods have been eliminated and many of the objections and difficulties are removed or overcome by the method worked out as described in this issue, and successfully applied to the construction of a long, wide, and high continuous concrete wall in deep water with moveable steel forms in which alternate sections of a perfect and accurate wall were successfully concreted and subsequently joined together to form one continuous structure by the use of the same forms for concreting the intermediate spaces.

This method secures a satisfactory foundation on solid rock by ordinary dredging methods; permits, examination of the surface and the adjustment of the form with a minimum of diver's work; and provides for the construction of massive 1,600-ton units in place, and their connection to form a single continuous wall of exact dimensions and assured quality at a cost probably considerably less than by the cofferdam, caisson or precast method.

The methods, with slight modifications, are apparently practicable for almost any ordinary conditions under which harbor work can be constructed, for a very wide range in the dimension of the structure and in the depth of the water. It requires only ordinary heavy floating equipment and the special forms; it eliminates a large amount of costly plant and labor required by other methods; and makes provision for satisfactory foundations, good bearing and the inspection of the bottom. By this method substructures may be built in very deep water or in shallow water; balanced pressures are maintained; continuous concreting secured, and expensive pumping and bracing avoided.

The special feature of the work is the idea of an adjustable, detachable steel form of large dimension and great rigidity suspended from a moveable tower astride of it that is seated on the bottom and provides for the adjustment, alignment and stripping of the form, which, with the tower, is moved as a unit from section to section as the structure is advanced.

The forms were designed and detailed by experienced contractors and form builders, and embody some of the principles that have been so successfully developed within the last few years for the construction and operation of forms for large tunnel construction.

Sewage Treatment in Imhoff Tanks

By Paul Hansen *

I have read with very great interest the series of articles by Mr. Russell Riker on "Sewage Treatment in Imhoff Tanks" and feel that we are indebted to him for some very instructive and valuable comparative data on Imhoff tank design and operation. I do not feel, however, that he has succeeded in "making a case" against the Imhoff tank as he apparently sets out to do. Rather he has called our attention to imperfections in design and operation and the existence of some uncertain factors in this connection that require further study and investigation.

He has not pointed out very satisfactorily any suitable alternative for the Imhoff tank except for rather vague references to septic tanks operated in rotation and sedimentation tanks with separate sludge digestion chambers. All of the methods which Mr. Riker mentions as means for overcoming the recognized evils of septic tanks were fully tried at Columbus, both in the preliminary experiments in 1904 and later in the full size plant. Primary and secondary tanks were provided and in the secondary tanks were placed hanging and submerged baffles all for the purpose of trapping the sludge thrown into suspension through ebullition. By the use of multiple tanks it was also presumed that when ebullition began in any tank, that tank could be shut off until sludge could be removed or until ebullition ceased. All of this, however, proved of little avail and much trouble resulted from clogging of sprinkler nozzles on the sprinkling filters and from bad odors, due to the staleness of the sewage as it reached the sprinkling filters.

Separate sludge digestion also proposed as a substitute for Imhoff tanks likewise has its difficulties, the principal one being that of promptly removing settled sludge to the sludge digestion chamber. A promising effort along this line is the combination of sedimentation tanks with Dorr plows and a separate sludge digestion tank or pit. I understand that the Dorr Company is conducting some experiments with this device at the present time at Rochester. It would seem that there should be no difficulty in obtaining results, but there is as yet the question as to whether the results can be reached with reasonable economy.

These comments on Mr. Riker's articles are not intended to argue the adequacy of the Imhoff tank but merely to indicate that it is probably the best mode of sewage sedimentation thus far devised. It may be superseded by better methods but it is also true that a better understanding of the design and operation will probably lead to better results and to better control over results. A lengthy paper might be written on the various imperfectly understood elements in Imhoff design and operation.

In 1911 I was one of the first to point out, in response to articles written by Mr. Hering, that we must guard against being hypnotized by the Imhoff tank as we were by the septic tank and that we should not hail this new tank as the solution of all of our sewage sedimentation troubles, but recognizing its obvious merits and demerits, it should be used cautiously and carefully. Everyone was inclined to admit at the start that the success of Imhoff tanks could only be predicated on correct and intelligent operation.

I see no reason to change from the above attitude, but I do believe we should not condemn the Imhoff tank until something assuredly better is before us and until we have fully exploited the still unknown or uncertain factors.

*Of Pearse, Greeley & Hansen, Consulting Engineers.

Another Discussion of Imhoff Tanks

The following discussion of the article on Imhoff tanks by Russell Riker has been contributed by M. B. Tark, engineer of the Link Belt Company of Philadelphia. Mr. Tark informs us that this is largely taken from the report of the Institute for Water Hygiene referred to, supplemented by views of Prof. Dr. Thumm, Dr. Kusch and Dr. Steuer, obtained by correspondence.

Mr. Riker's article will be carefully studied by every designing engineer and operator of sewage treatment plants and the result will be a number of better designed and better operated plants. A comparison of his investigations with those made by the Institute of Water Hygiene, Berlin-Dahlen, shows that the experience with Imhoff Tanks in Germany has been very much the same as in New Jersey. If anything it has been worse, principally because it has been longer.

Fortunately or unfortunately, the first tanks built by the Emscher Sanitary District gave excellent results, due to the composition of the local sewage. But as soon as tanks were constructed in other parts of the country, complaints began to come in. Conditions became so bad in many plants, that after a year of investigation the Institute built an experimental tank, in which an agitator in the digesting chamber was installed. Practically all troubles—acid, undigested sludge, scum and foaming, were due to the digesting chamber; careful operation was the remedy.

Maintenance of an alkaline reaction in all parts of the digesting chamber was found absolutely essential to the proper putrefactive decomposition of the sludge. Samples must be taken not only of the sewage and sludge, but also of the supernatant water in the digesting chamber. This is regarded as the factor of safety in the operation of the plant and *the proportion of 2 parts of sludge to 1 part of supernatant water* must be strictly adhered to. Only in old ripe tanks or in those handling septic sewage can this proportion be changed. Septic sew-

age is strongly alkaline, has lost its gas-forming ability and therefore will very seldom cause trouble. The fresh sludge should be thoroughly mixed with the supernatant water, but it is not desirable to mix the digested with the fresh sludge, as it is quite possible for digested sludge to become acid again. The mixing of the incoming sludge with supernatant water was accomplished by running the agitator for a short time every day. In some of the older plants the mixing was done successfully by blowing air through the pressure pipe, in others water was tried, giving good results in some cases and making conditions much worse in others.

Scum and foaming are most serious during the period of ripening. Scum is settled sludge and its floating ability is due to its contents of the gases of decomposition. Large particles, especially feces, retain their floating ability longer than smaller ones, they should therefore be kept out of the tank by screens. Breaking up and sinking the scum by a hose or paddling is less effective than the use of an agitator. If a hose is used, sewage is preferable to water. Foaming in an unripe digesting chamber is only a secondary phenomenon, it is caused by large amounts of gas rising to a small surface and carrying the sewage and finely divided sludge with it in the form of bubbles. The gas vents should be not less than 25 per cent of the total area of the tank.

In ripe tanks the scum formation will not be nearly so heavy or so offensive, but the scum will have to be removed from time to time.

On the principle that prevention is better than cure, the Institute cautioned municipalities not to pay for the tanks until the digesting chamber is ripe and the whole plant in good working order. It also recommends the installation of sedimentation tanks with separate sludge digesting chambers. A number of these tanks of various types have been built and given good results.

Many of our leading engineers now prefer fine screens to tank, especially where the effluent is treated on sprinkling filters or where the composition of the sewage makes the successful operation of a digesting tank doubtful or improbable.

State Licensing of Engineers*

RECIPROCITY BETWEEN STATES

All of the states grant reciprocity in the matter of licenses to the extent of not requiring an examination of applicants, but all require the payment of the same fee as is required of resident engineers. However, engineers who serve as consulting associates of an engineer registered under the provisions of the Act are not required to be licensed in Louisiana, North Carolina, Tennessee, Minnesota and West Virginia, but must prove their competency to serve in such capacity.

Certain of the states permit engineers residing in other states to practice for a limited number of days without requiring a license. North Carolina permits this up to 30 days in each year; Arizona 30 days; Colorado 90 days; Tennessee 15 days; New Jersey 30 days; Minnesota 30 days; New York 30 days; Oregon 30 days; Pennsylvania 30 days; West Virginia 30 days. In each of these cases, it is specified that this privilege is granted only to those who are legally qualified for such professional services in their own state. In Oregon it is required that an engineer, to obtain such exemption, must "first give notice in writing to the board of engineering examiners of his intention to practice in Oregon."

*Concluded from page 209.

AMOUNT OF LICENSE FEE

The fees required by the various states are as follows: $25 in Florida, Iowa, Louisiana, North Carolina, Indiana, Tennessee, New Jersey, Minnesota and New York; $20 in Michigan, Virginia, Pennsylvania and West Virginia; $15 in Arizona, Colorado and Oregon. These are for license for engineers. The same fees are required for license for surveyors except in North Carolina and Arizona, where surveyors' license is $10.

In New Jersey and New York, the license is $25 for either engineering or surveying or $35 for both. In Pennsylvania license is $20 for either or $30 for both. The license must be renewed each year, renewals costing $5 in Florida, Michigan, North Carolina, Arizona, Colorado, Tennessee and Minnesota. Renewals cost $1 for surveying and $3 for engineering in Louisiana; $10 in Indiana and West Virginia; $1 in New Jersey, New York and Pennsylvania and $3 in Oregon.

In addition to the license fee, it is required in New Jersey that the license be recorded and the fee for recording be paid. A number of the states require that a seal be purchased and used on certain specified classes of maps and documents.

REQUIREMENTS FOR LICENSE

Requirements for receiving a certificate are quite similar in all the states, although several have minor peculiarities of their own. Practically all require that the applicant be of good moral character. He must be at least 21 years of age in Florida, Michigan, Louisiana, Virginia, North Carolina, New Jersey, New York and Oregon, and 25 years in Iowa, Arizona, Indiana, Colorado, Minnesota and Pennsylcania.

In Florida he must have had 6 years' practice in engineering and at least 1 year in charge of work, or be a graduate of an engineering school with 4 years of practice, one of them in charge of work. In Iowa, he must have 6 years' practice, one in charge, but each year successfully passed in an approved engineering school is accepted for one year of practice. Michigan requires 6 years' practice, or graduation plus 2 years. In Louisiana the recipient of a license must be a graduate of an engineering school or must pass a satisfactory examination in surveying, plane trigonometry and the use of instruments, with the addition of natural philosophy for an engineering license. In Virginia he must pass an examination, satisfying the board as to his practical experience and general ability and have had at least 4 years or practical experience under a certified professional engineer, or be a graduate of an engineering school.

North Carolina requires 5 years of practice or in teaching or studying engineering, time spent by an

engineering student in the army, navy or marines during the World War being considered as an equivalent time of experience; or he may be a graduate of an approved engineering school. Or, he may be a full member of the American Society of Civil Engineers, American Institute of Chemical Engineers, American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Naval Architects and Marine Engineers, "or such other national or state engineering or architectural societies as may be approved by the board, the requirements for full membership of which are not lower than the requirements for full membership in the professional societies or institutes named above." Membership in same societies is also accepted in Arizona, Tennessee and West Virginia. Arizona required 3 years of practice, teaching or study of engineering, or society membership. Indiana requires 10 years of practice, or graduation as engineer and 4 years' practice. Colorado requires 7 years' practice, teaching or study. Tennessee requires 10 years' practice, or graduation and 4 years' practice, or society membership. New Jersey requires 6 years' practice, one in charge of work, or graduation and 4 years' practice. Minnesota requires 6 years' practice, teaching or study. New York requires 6 years' practice, one in charge of work, or graduation and 4 years' practice. Oregon requires 6 years, one in charge of work, or graduation and 2 years. Pennsylvania requires 10 years' practice, or graduation and 4 years. West Virginia requires 10 years' practice or graduation and 4 years, or society membership.

In the above, it will be noticed that graduation from an engineering school has been given increasing weight during the later years. Florida in 1917, accepted graduation from an engineering school as equivalent to 2 years of practice. Michigan and Iowa in 1919, accepted graduation as equivalent to 4 years' practice, as did Virginia in 1920. In 1921, North Carolina accepted graduation as equivalent to 5 years' practice and Colorado, Tennessee, Pennsylvania and West Virginia accepted graduation after a 4 years' course as equivalent to 6 years of practice. In the same year, however, New Jersey and New York accepted graduation as equivalent to only 2 years of practice and Oregon as equivalent to 4 years.

Practically all of the states require that an engineer, to receive a license, must be a citizen of the United States or of Canada and speak and write the English language. Several of the states grant licenses to those who have declared their intention to become citizens of the United States. Pennsylvania permits licenses to citizens of foreign countries who have practiced engineering for a period of more than 10 years, upon presentation of satisfactory evidence that he is qualified to practice and at the discretion of the board. New Jersey gives special emphasis to the fact that, in determining the qualification of applicants, "character shall be given predominant weight."

The above are the principal features as they affect engineers. A considerable part of each of the state laws deals with the board of registration, detailing how it shall be constituted, the duties of the secretary and treasurer, etc. The laws include a statement of the penalties for acting or attempting to act as engineer without securing a license, for misrepresentation in securing a license, etc. Provision is made in each Act also for a revocation of license by the board, generally providing that any person may prefer charges of fraud, incompetency or other acts or characteristics making it undesirable that the engineer retain his license and providing for hearings before the board and, in some cases, appeals from the board to the courts. The penalty in most cases is $100 or more or imprisonment for from 3 months to several years.

ADDRESSES OF STATE BOARDS

The details of application of the laws will lie to a considerable extent with the boards and be set forth in the rules and regulations adopted by them and which can be obtained on application. In the absence of more definite information, applications addressed to the state board of registration at the capital of the State would probably reach the proper parties. The list below, however, gives the officials now (or recently) in office, who may be addressed for further information:

Arizona—State Board of Registration for Architects, Engineers, Land Surveyors and Assayers. Secretary, L. B. Hitchcock, Room 7, City Hall, Phoenix.

Colorado—State Board of Engineer Examiners. Secretary, Addison J. McCune, state engineer, Capitol Building, Denver.

Florida—State Board of Engineering Examiners, 215 E. Bay Street, Jacksonville. Secretary-treasurer, A. D. Stevens, Jacksonville.

Indiana—State Board of Registration for Professional Engineers and Land Surveyors. Secretary, DeWitt Moore, State Capitol, Indianapolis.

Iowa—State Board of Engineering Examiners. Secretary, Earl C. Kastberg, Box 923, Des Moines, Ia.

Louisiana—State Board of Engineering Examiners, 815-17 Maison Blanche Bldg., Annex, New Orleans. Secretary, Donald Derickson, New Orleans.

Michigan—State Board for the Examination and Registration of Architects, Engineers and Surveyors. Secretary, C. T. Olmstead, 80 Griswold Street, Detroit.

Minnesota—State Board of Registration for Architects, Professional Engineers and Land Surveyors. Secretary-treasurer, R. T. Downs, 804 Phoenix Bldg., Minneapolis.

New Jersey—State Board of Professional Engineers and Land Surveyors. Trenton.

New York—State Board of Licensing for Professional Engineers and Land Surveyors. Secretary, H. G. Reist, General Electrical Company, Schenectady.

North Carolina—State Board of Registration for Engineers and Land Surveyors. Secretary, Harry Tucker, 1301 Hillsboro Road, West Raleigh.

Oregon—State Board of Engineering Examiners, 520 Corbett Bldg., Portland. Secretary, A. B. Carter.

Pennsylvania—State Board for Registration of Professional Engineers and Land Surveyors, State Capitol, Harrisburg. Chairman, Richard L. Humphreys, 805 Harrison Bldg., Philadelphia.

Tennessee—State Board of Architecture and Engineering Examiners. Secretary, Henry C. Hibbs, 4th and 1st Bank Bldg., Nashville.

Virginia—State Board of Examination and Certification of Architects, Professional Engineers and Land Surveyors. Secretary, C. G. Massie, Amherst.

West Virginia—State Board of Registration for Engineers. Secretary, Geo. E. Taylor, 504 Coyle & Richardson Bldg., Charleston.

Table No. 1—City Paving Done in 1921

Supplementary data to those published in the issue of February 18th, giving all returns received since the data first received were compiled. Continued from last week.

II—Warrenite-Bitulithic and Concrete

Name of City	Warrenite-Bitulithic Area	Warrenite-Bitulithic Cost	Concrete Area	Concrete Cost
Illinois:				
Alton	....	......	1,405	......
Ashton	....	......	24,897	......
Barrington	....	......	16,371	......
Belleville	....	......	9,866	4.02
Belvidere	....	......	1,056	......
Berwyn	....	......	32,365	......
Carlinville	....	......	5,880	......
Chicago	....	......	230,715	......
Durand	....	......	5,820	......
E. St. Louis	....	......	9,720	......
Effingham	....	......	13,612	......
Elgin	....	......	18,079	......
Freeport	....	......	9,744	39,553.00
Glencoe	....	......	12,050	4.59
Harvey	....	......	14,877	......
Johnson City	....	......	10,992	4.76
Kankakee	....	......	1,185	......
La Salle	....	......	11,925	......
Martinsville	....	......	4,101	......
Morris	....	......	3,295	......
North Chicago	....	......	27,200	......
Oak Park	....	......	15,067	51,358.00
Paris	....	......	7,600	......
Plainfield	....	......	23,994	3.53
Robinson	....	......	12,614	1.95-4.45
Rockford	....	......	9,160	2.55
South Beloit	....	......	60	......
Urbana	....	......	30,200	4.52
W. Frankfort	....	......	13,069	4.21
W. Hammond	....	......	13,568	......
Winnetka	....	......	3,501	......
Wood River	....	......	30,130	......
Indiana:				
Anderson	....	......	6,461	3.15
Avilla	....	......	3,299	3.44
Columbia City	....	......	3,260	......
Connersville	....	......	5,470	......
East Chicago	....	......	14,480	......
Fremont	....	......	15,972	......
Greencastle	....	......	7,986	......
Indianapolis	....	......	69,168	3.70-3.75
Kokomo	....	......	8,636	......
Logansport	....	......	50,000	......
Louisvile	....	......	12,255	......
Marshalltown	....	......	6,800	3.37-3.58
Michigan City	....	......	2,500	......
Middletown	....	......	13,741	2.67
Muncie	....	......	5,658	3.69
Newcastle	....	......	36,000	2.60
Richmond	....	......	20,215	2.25-3.26
Terre Haute	....	......	17,758	......
Winchester	....	......	1,000	......
Wolcottville	....	......	7,322	......
Iowa:				
Burlington	....	......	35,037	1.79-3.35
Cedar Rapids	....	......	12,276	4.18
Charles City	....	......	4,400	3.48
Council Bluffs	....	......	1,300	3.95
Davenport	....	......	28,278	2.05-2.48
Denison	....	......	100,000	500,000.00
De Witt	....	......	26,950	3.19-3.69
Dubuque	6,818	......	....	......
Eldora	....	......	13,575	2.97
Kenwood	....	......	3,155	......
Le Mars	....	......	330	852.00
Mason City	....	......	2,900	3.40
Missouri Valley	....	......	78,262	2.30-2.99
Mt. Pleasant	....	......	1,700	3.45-3.50
Orange City	39,303	......	....	......
Paullina	....	......	2,000	3.58
Parkersburg	26,686	......	....	......
Rudd	....	......	3,900	4.96
Sheldon	....	......	61,244	3.18-3.35
Sibley	....	......	77,100	3.47
Sioux City	....	......	132,770	2.79-3.99
Spirit Lake	....	......	15,147	3.35
Waukon	....	......	4,000	3.93
Kansas:				
Bonner Springs	....	......	4,378	2.30
Effingham	....	......	2,483	3.35
Hutchinson	....	......	7,000	2.44-2.48
Iola	....	......	12,107	2.45
Kansas City	15,114	......	92,185	2.05-2.68
Lawrence	....	......	7,300	2.85
Leavenworth	....	......	14,899	2.36-2.50
Kansas—Continued				
Manhattan	....	......	1,120	2.90
Minneapolis	....	......	26,925	3.26
Osawatomie	....	......	6,500	2.43
Pittsburg	....	......	2,007	3.05
Wellington	....	......	4,300	3.00
Kentucky:				
Beattyville	....	......	7,740	3.05
Central City	....	......	522	......
Corbin	....	......	3,783	3.00
Cote Brilliant	....	......	600	2.65
Dayton	....	......	1,580	2.30
Jackson	....	......	1,331	......
Lexington	....	......	12,030	2.89-3.34
Louisville	....	......	22,597	1.49-1.53
Mt. Sterling	....	......	11,155	......
Newport	....	......	10,258	2.03-2.32
Paducah	....	......	40,000	2.21
Pineville	....	......	786	......
Prestonburg	....	......	20,000	......
Williamstown	....	......	16,068	......
Louisiana:				
Baton Rouge	....	......	920	......
New Iberia	....	......	15,000	2.76
New Orleans	56,457	368,083.00	....	......
Shreveport	....	......	3,110	......
Maine:				
Bangor	....	......	11,000	......
Bath	....	......	4,200	......
Brunswick	....	......	4,500	......
Fairfield	....	......	866	......
Foxcroft	....	......	555	......
Saco	....	......	1,832	3.56
Maryland:				
Baltimore	....	......	16,560	2.06
Cumberland	....	......	8,440	3.47-4.50
Massachusetts:				
Boston	10,574	3.09	....	......
Brookline	3,335	7,337.00	....	......
Chicopee	....	......	2,980	......
Chelsea	46,547	......	....	......
Chicopee Falls	....	......	400	......
Everett	....	......	12,029	......
Fairview	....	......	3,000	......
Fall River	75,818	......	....	......
Framingham	....	......	2,500	2.50
Gardner	....	......	35,000	......
Gilbertville	....	......	2,040	......
Great Barrington	....	......	11,800	......
Greenfield	....	......	8,700	58,000.00
Hadley Falls	....	......	710	......
Haverhill	18,021	......	....	......
Housatonic	....	......	6,743	......
Leominster	....	......	1,556	......
Malden	....	......	1,174	......
New Bedford	139,566	395,500.00	....	......
North Adams	....	......	1,836	2.62
Northampton	....	......	1,230	......
North Dighton	....	......	14,653	......
Revere	....	......	2,000	2.00
Shrewsbury	....	......	2,134	......
Southbridge	....	......	3,945	......
Taunton	....	......	5,060	3.49
Uxbridge	....	......	12,512	......
Ware	....	......	10,160	......
Watertown	....	......	18,316	3.40
Wellesley	1,570	......	....	......
Willimansett	....	......	4,030	......
Worcester	....	......	5,557	22,523.00
Michigan:				
Allegan	....	......	11,218	1.60-2.70
Belding	....	......	4,100	......
Dearborn	....	......	9,300	3,102.00
Ecorse	....	......	10,000	2.95-3.00
Hartford	....	......	3,350	2.65
Hind	....	......	16,000	2.64
Lansing	....	......	5,000	......
Menominee	....	......	27,128	......
Monroe	....	......	36,800	......
Mt. Pleasant	....	......	5,000	......
Muskegon	....	......	64,553	......
Otsego	....	......	15,000	2.48
Port Huron	....	......	41,771	164,792.00
River Rouge	....	......	38,660	2.65-3.00
Royal Oak	....	......	9,312	2.40
Standish	....	......	10,266	......
Sturgis	....	......	18,156	2.30
Three Rivers	....	......	11,374	2.80
Union City	....	......	5,581	2.58

Name of City	Warrenite-Bitulithic		Concrete	
	Area	Cost	Area	Cost
Minnesota:				
Brainerd	....	......	13,650	2.70-2.93
Breckenridge	....	......	49,233	......
Eveleth	....	2,973,00	....	......
Farmington	29,861	......	....	......
Hastings	17,994	......	....	......
International Falls	....	......	18,250	3.08-3.58
Luverne	....	......	160,000	510,000.00
Mankato	....	......	5,850	2.20-2.34
Minneapolis	....	......	29,159	......
Northfield	....	......	25,000	2.91
Slayton	....	......	14,563	2.68
St. James	....	......	18,700	2.73-3.10
Thief River Falls	42,435	......	....	......
Virginia	....	......	47,957	134,098.00
Wardena	....	......	16,391	2.54
Mississippi:				
Jackson	....	......	47,006	1.70-1.89
Vicksburg	....	......	2,500	7,000.00
Missouri:				
Albany	....	......	3,000	......
Booneville	....	......	11,187	1.65-1.71
Cape Girardeau	....	......	23,500	54,000.00
Cherokee	....	......	45,470	2.05
Clinton	....	......	1,350	......
Columbia	....	......	2,240	2.25
Fayette	....	......	2,412	2.20
Illmo	....	......	2,070	2.68
Maplewood	....	......	22,128	1.90-2.50
Mt. Grove	....	......	5,800	......
No. Kansas City	....	......	7,500	2.50
St. Joseph	....	......	19,502	2.40-3.75
University City	....	......	2,510	2.45
Montana:				
Billings	....	......	6,604	28,654.00
Bozeman	2,717	......	....	......
Deer Lodgs	....	......	17,137	3.10
Great Falls	....	......	18,957	2.62½
Kalispell	....	......	6,800	3.26
Lewiston	....	......	12,728	2.98½
Roundup	6,075	......	....	......
Nebraska:				
Broken Bow	....	......	7,023	......
Butler	....	......	1,944	2.88
Chadron	58,519	......	....	......
Nelson	....	......	16,908	2.28
North Platte	....	......	1,500	3.20
Pawnee	....	......	31,403	2.24
Plattsmouth	....	......	13,812	2.55
New Hampshire:				
Keene	....	......	9,958	2.58
Lebanon	....	......	530	......
Manchester	....	......	750	......
Nashua	....	......	15,781	2.50
New Jersey:				
Allenhurst	7,088	......	....	......
Altoona	....	......	2,527	3.40-4.05
Asbury Park	23,351	......	....	......
Bordentown	....	......	1,200	2.95
Belleville	6,287	......	3,650	2.60
Beverly	....	......	7,456	......
Belvidere	....	......	13,700	3.25
Bridgetown	....	......	455	2.32
Butler	....	......	2,666	......
Cranford	....	......	7,100	2.80
Dover	1,115	......	....	......
Elizabeth	....	......	24,172	2.73-2.95
Hasbrouck Hgts.	....	......	2,627	4.00
Hohokus	....	......	675	......
Kearney	36,372	......	20,600	2.85-2.98
Little Ferry	....	......	7,597	3.20
Metuchen	....	......	12,000	2.90
Ocean	5,784	......	....	......
Orange	8,029	......	590	3.00
Pennsville	....	......	4,434	2.55
Perth Amboy	18,581	......	....	......
Ramsey	....	......	11,035	3.39
Red Bank	....	......	6,545	2.79
Ridgefield Park	....	......	12,300	2.45
Roselle Park	....	......	37,000	210,650.00
Somerville	....	......	15,124	......
South Orange	....	......	4,200	2.75
South River	6,000	......	....	......
Spring Lake	....	......	14,000	......
Trenton	....	......	12,909	2.37-2.98
Union	....	......	7,800	......
Washington	....	......	7,117	......
Westfield	....	......	16,500	65,000.00
West Orange	2,030	......	....	......
Woodbridge	7,294	......	....	......
New Mexico:				
Albuqurque	6,336	......	....	......
Carlsbad	....	......	29,308	......
Clovis	42,000	4.45	....	......
Las Cruces	....	......	12,046	2.53
Las Vegas	42,946	......	....	......
Raton	21,903	......	22,134	3.12
New York:				
Afton	....	......	7,044	4.26
Albian	....	......	13,700	......
Alden	....	......	980	......
Amenia	....	......	2,400	......
New York:				
Amityville	....	......	20,264	2.69-2.96
Amsterdam	....	......	9,183	3.22
Attica	....	......	17,280	3.00
Auburn	....	......	4,274	2.80
Avoca	....	......	6,611	......
Bath	....	......	2,700	......
Babylon	....	......	5,800	......
Bayshore	....	......	3,350	......
Boonville	....	......	4,623	......
Brocton	....	......	4,050	2.70
Carthage	....	......	1,500	2.50
Cohoes	9,900	......	2,668	3.20
Croton on Hudson	....	......	2,200	......
Dolgeville	....	......	5,170	3.40
Earlville	....	......	7,200	2.43
Easthampton	....	......	463	......
Ellicottville	....	......	11,059	3.63
Ellington	....	......	2,246	......
Elmira	12,323	......	....	......
Felt Mills	....	......	850	......
Forest Hills	....	......	3,300	2.75
Frankfort	....	......	1,340	2.65
Ft. Niagara	....	......	7,150	2,517.00
Garden City	....	......	8,400	3.25
Goshen	....	......	300	......
Hamburg	....	......	1,120	......
Harriman	....	......	4,444	2.79
Hempstead	....	......	3,600	3.25
Horseheads	....	......	996	......
Huntington	....	......	3,844	2.64
Ilion	....	......	12,700	2.75
Inwood	....	......	3,352	3.30
Ithaca	....	......	2,888	......
Lancaster	....	......	16,300	......
Liberty	....	......	10,055	......
Lindenhurst	....	......	848	1.95
Livingston Manor	....	......	1,511	......
Long Beach	....	......	4,333	......
Lydonville	....	......	3,100	......
Lyons Falls	....	......	13,900	......
Massena	....	......	1,200	......
Mechanicsville	....	......	10,700	2.45-2.53
Medina	....	......	20,650	......
Milford	....	......	3,300	1.97
Mt. Vernon	....	......	3,550	2.69
Newark	....	......	2,000	2.59
Newburgh	....	......	16,258	3.53
New Hartford	....	......	10,500	3.33
Northport	....	......	18,700	2.60
Ogdensburg	....	......	13,000	2.78
Orient	....	......	6,570	......
Ossining	....	......	9,900	1.50
Oswego	....	......	22,000	......
Oxford	....	......	3,800	2.00
Oyster Bay	....	......	1,460	......
Palmyra	....	......	840	......
Pt. Jefferson	....	......	1,100	2.37
Phelps	....	......	2,500	3.25
Rome	19,757	......	....	......
Scotia	....	......	21,286	2.16-2.49
Syracuse	....	......	9,720	2.10-3.50
Troy	35,000	3.65	16,200	3.00-3.80
Utica	28,624	......	3,285	2.85-3.10
Wappinger Falls	....	......	1,200	......
Warwick	....	......	13,200	......
Westervliet	....	......	37,598	2.46-3.25
West Carthage	....	......	4,400	......
White Hall	....	......	10,090	......
White Plains	....	......	8,088	2.83-2.93
Yorkville	....	......	4,381	3.25
Yonkers	12.936	......	....	......
North Carolina:				
Charlotte	....	......	32,400	2.48
Cherryville	....	......	15,000	......
Greenville	....	......	5,200	......
Forest City	....	......	2,000	......
Hickory	56,971	......	....	......
High Point	18,279	......	....	......
Marion	....	......	5,200	......
Mocksville	....	......	11,000	2.77
Morgantown	....	......	12,000	......
Pitts	....	......	3,000	......
Rowan	....	......	15,000	......
Rutherfordton	....	......	10,000	2.40
Salisbury	67,783	......	....	......
Scotland	....	......	3,000	......
Winston-Salem	30,576	......	2,000	......
North Dakota:				
Grand Forks City	....	......	98,300	437,499.00
Grafton	45,205	......	....	......
Ohio:				
Andover	....	......	14,400	......
Antwerp	....	......	5,036	......
Ashland	....	......	4,344	4.02
Bellefontaine	....	......	15,580	43,000.00
Bowling Green	....	......	1,320	......
Cincinnati	....	......	10,750	......
Columbus	....	......	1,860	......
Dayton	....	......	31,030	101,000.00
Edgerton	....	......	3,717	......
Ft. Recovery	....	......	4,333	......

(*To be continued*)

NEWS OF THE SOCIETIES

CALENDAR

Apr. 3-5—NATIONAL FEDERATION OF CONSTRUCTION INDUSTRIES. Drake Hotel, Chicago.

Apr. 5-6—AMERICAN SOCIETY OF CIVIL ENGINEERS. Spring society meeting. Dayton, Ohio.

Apr. 10 — LINCOLN, NEBRASKA, CHAPTER, AMERICAN ASSOCIATION OF ENGINEERS. Joint meeting with Nebraska Chapter, A. S. C. E., and student chapters of these two organizations at University of Nebraska.

Apr. 11—ENGINEERS SOCIETY OF BUFFALO. Engineers' Club, Hotel Iroquois. Secretary—N. L. Nussbaumer, 80 W. Genessee St., Buffalo.

Apr. 11—SOCIETY OF INDUSTRIAL ENGINEERS. Auditorium Hotel, Chicago.

Apr. 19—NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies Bldg., New York City.

Apr. 19-21—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. General meeting. Chicago, Ill.

Apr. 19-21 — TRI-STATE WATER AND LIGHT ASSOCIATION OF THE CAROLINAS AND GEORGIA. Spartanburg, S. C.

Apr. 25-28—BUILDING OFFICIALS' CONFERENCE. Annual meeting. Hotel Lincoln, Indianapolis, Ind.

Apr. 26-28—SOCIETY OF INDUSTRIAL ENGINEERS. National spring convention. Detroit, Mich.

Apr. 27-29—BUILDING OFFICIALS' CONFERENCE. April 27-28, Cleveland, O.; April 29, Massillon, O.; April 30, Youngstown, O.

Apr. 29—DETROIT ENGINEERING SOCIETY. Hotel Cadillac, Detroit, Mich.

May 8-12—AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Atlanta, Georgia.

May 15-19 — AMERICAN WATER WORKS ASSOCIATION. 42d annual convention. Bellevue-Stratford Hotel, Philadelphia. Secretary, J. M. Diven, 153 W. 71st St., New York.

May 15-19—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention. Atlantic City, N. J.

May 16-18—CHAMBER OF COMMERCE OF U. S. A. 10th annual meeting. Washington, D. C.

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. 8th annual convention. Salt Lake City, Utah.

June 13-16—CANADIAN GOOD ROADS ASSOCIATION. Annual convention. Victoria, B. C.

June 19-22—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Summer meeting. Clifton Hotel, Niagara Falls.

June 26-July 1—AMERICAN SOCIETY FOR TESTING MATERIALS. 25th annual meeting. Chalfonte-Hadden Hall Hotel, Atlantic City, N. J.

Sept. 11-15—ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. New Auditorium, Cleveland, Ohio.

Sept. 25-28—SOUTHWEST WATER WORKS ASSOCIATION. Annual convention. Hot Springs, Ark.

Oct. 9-13—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Cleveland, Ohio.

THE TRI-STATE WATER AND LIGHT ASSOCIATION OF THE CAROLINAS AND GEORGIA

The Twelfth Annual Convention will be held at the Chamber of Commerce Building, Spartanburg, S. C., April 19-21.

PROGRAM, APRIL 19.

Morning Session.—Business Meeting. President's Address. Appointment of Committees on: Auditing of Accounts, Secretary and Treasurer. Nominating Committee Officers for ensuing year. Committee to select place of holding the next Convention. Exhibition Committee. Special Committee. New Business.

Afternoon Session.—"Laws Affecting the Operating of Public Utility Companies," by Geo. H. Moffett; "Laws Affecting Liability of Public Utility Companies, Occupying Highways with their Structures," by H. M. Callaghan. Sightseeing automobile ride.

Evening Session.—Address of Welcome, by the President of the Spartanburg Chamber of Commerce.

Response to Address of Welcome, A. J. Sproles. "Spartanburg, its History and Industries, Commerce, Homes and People," by E. B. Walker. "The Water Works of Spartanburg," by R. B. Simms. "The Electric Light and Power Facilities of Spartanburg," by Geo. B. Tripp.

Informal "Get Acquainted" Reception.

APRIL 20

Morning Session.—"New Fourteen-Million Gallons Concrete Filter Plant of the Water Department, Charleston, S. C.," by F. B. McDowell; "The Recent Drought in North Carolina and its Effects on the Water Supply," by H. E. Miller.

TOPICAL DISCUSSIONS ON WATER SUPPLY

What measures are you taking to protect your drainage areas and reservoirs from pollution by trespassers, such as hunters, fishermen, berry pickers, campers, construction camps and from the population residing on the drainage area?

Are you suffering from electrolysis, and what have you done to overcome the difficulty?

Is your water supply entirely satisfactory and is it acid or alkaline?

Have you experienced trouble with corrosion or incrustation of your water mains or service pipes?

Are you troubled with tastes, odors or algae?

Is your water free from bacteria? What are you doing to overcome these difficulties?

Do you filter your water supply?

Do you chlorinate your water supply? What results are you obtaining?

Afternoon Session.—"Accounting for Public Utilities," by C. L. Vann; "Mechanical Aids in Public Utility Accounting," by G. T. Moore; "Accounting Forms for Public Utilities," by R. E. Plimpton; "Distribution of Electricity from Central Stations," by H. F. Lee.

Collection of delinquent bills.

Collection of bills in case of transfer of property, and change of tenant between regular meter readings without notice to office of such change.

Does city pay for water, light and power for municipal purposes?

How do you measure water supply for sewer flushing and street sprinkling?

Do you have a regular plant schedule which provides for periodic inspection of all mechanical equipment?

Do you employ technically trained men to supervise your boiler room where your pocketbook is so vitally affected?

Are your demand contracts for power written on the kilowatt basis, while the actual load on is on the kilo volt ampere basis, tying up capacity without return?

Do you have frequent insulator troubles due to dust or other influences incidental to the industry supplied?

What has been your experience with joint occupation of poles with other utility companies?

Have you ever proven to your own satisfaction how often electric meters of different classes should be tested and overhauled?

Supper to Delegates and Guests—Compliments of the Spartanburg Water Works Commission and the Chamber of Commerce.

Evening Session.—"The Handling of the Public," by O. H. Bissell; "What South Carolina is Doing to Protect the Public Water Supplies and the Streams of the State," by E. L. Filby; "What North Carolina is Doing to Protect the Public Water Supplies and the Streams of the State," by H. E. Miller; What Georgia is Doing to Protect the Public Water Supplies and the Streams of the State," by H. C. Woodfall.

TOPICAL DISCUSSIONS

Emergency connections between public water supply systems and private water supplies for fire purposes; method adopted to prevent pollution of the city supply from private sources.

Discussion opened by a representative of the Underwriters' Association.

Continuation of Topical Discussion.

APRIL 21

Morning Session.—"Discussions of and Experiments in Hydrogen-ion Control of Colored Waters," by E. P. Verner; "The Installation of Underground Structures Previous to the Laying of Permanent Roadway Improvements. Upon Whom Should the Burden be Placed?" by W. S. Tomlinson. Five Minute Talks, by Representatives of Exhibitors.

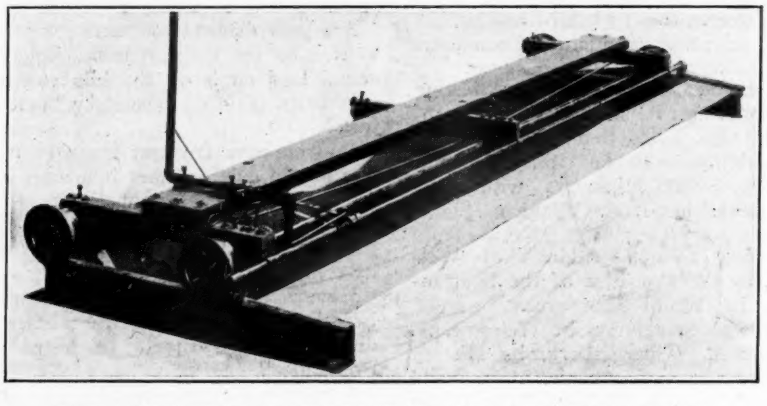
Afternoon Session.—"Reciprocating Pumping Engines," by R. D. Hall; "Metering Public Water Supplies, Experiences and Results Obtained," by C. N. Grantham; "Water Rates," by Wilder M. Rich.

Business Meeting.—Discussion of The Tri-State Water and Light Association, its Opportunities and Future, and What can be Done to Increase its Influence. Reports of Committees. Selection of place of holding the next Convention. Election and Installation of Officers.

Evening Session.—Popular Lecture, "Sanitary Engineering in the Holy Land," by H. Y. Carson, U. S. Captain of Engineers, attached to Gen. Allenby's Staff on his "push" to Jerusalem.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



THE LAKEWOOD FLOAT-BRIDGE AND FINISHING BELT

THE LAKEWOOD FLOAT-BRIDGE

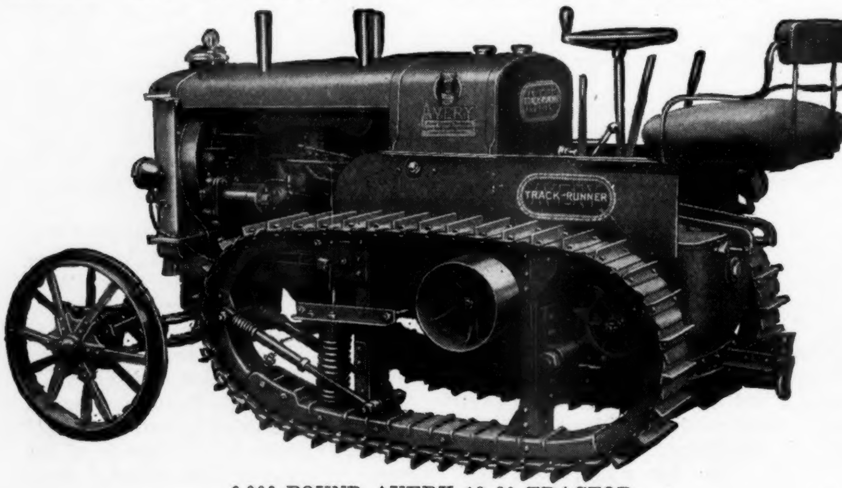
The Lakewood Engineering Company has brought out a new item of equipment for concrete road construction known as the Lakewood Float-Bridge, which is a hand operated belt float and substantial bridge combined. One man operates the lever which moves the belt back and forth across the pavement, at the same time automatically advancing the machine a little with each stroke. The traction mechanism can be instantly thrown out of gear so that the Float-Bridge can be pushed forward or backward. The belt can be raised off the pavement and is automatically held up until released.

On many concrete paving jobs it has been found that a final belting some little time after the pavement has been struck off, tamped, and surfaced, does much to prevent hair cracks and also gives a better surface. Time does not allow the finishing machine to go back and do this final belting, and it was primarily for this work that the Float-Bridge was developed. It gives the contractor doing hand finishing a one-man operated belting device. It provides a strong bridge across the road, carried on wheels traveling on the side forms, and is easily moved by one man.

NEW AVERY 12-20 TRACTOR

A new 12-20 h.p. tractor just put on the market by the Avery Co. is equipped with the Avery draft horse motor with four 4½-inch cylinders having a 6-inch stroke, making 800 rpm, and weighing 1,250 pounds. There is a direct drive, spur gear transmission and other Avery features and improvements. The machine can be operated on gasoline, or kerosene, or distillate fuel or on gasoline and kerosene mixed. It has two speeds of 2¾ and of 4¼ miles per hour, a wheel base of 80 inches, the front and rear tread are 42 inches and 48 inches respectively and the turning radius is 9 feet.

This tract is designed to include the best features of Avery improved mechanical construction with strength, simplicity, durability and efficiency. It is adapted for hauling, excavating and grading machines and trailers. The total weight of the tractor without fuel, oil, water or lugs is 6,000 pounds.



6,000-POUND AVERY 12-20 TRACTOR

INDUSTRIAL NOTES

Stroud & Co., Omaha, manufacturer of the "Little Red Wagon" and the Stroud elevating grader, has opened a branch at 640 Temple Court, Minneapolis, with J. C. Yetter in charge as sales representative.

The Westinghouse Electric & Manufacturing Co. has announced the following changes in personnel: R. L. Rathbone, branch manager of the Cleveland office, will take up special duties in connection with merchandising matters; J. Andrews, Jr., has been appointed manager in his stead of the Cleveland office, and C. D. Taylor succeeds Mr. Andrews in the Pittsburgh office. R. Seybold has been appointed manager of price statistics and will assist W. S. Rugg, assistant to the vice president in the latter's general duties. Also, W. R. Keagy has been appointed office manager of the Cincinnati office, and J. R. Deering, office manager of the Los Angeles office. H. S. Walker is to be promotion man in the Denver office, I. G. Cline in the Chicago office, and K. L. Graham in the San Francisco office.

The Barber-Greene Co., manufacturers of standardized material handling machines, Aurora, Ill., has added to its list of representatives the Good Roads Supply Co., Ford Bldg., Detroit, Mich.

The United States Cast Iron Pipe and Foundry Co., Burlington, N. J., has opened an office in Kansas City, Mo., with D. W. Pratt in charge.

The Federal Road Builders' Manufacturing Co. has been organized at Indianapolis for the erection of steel and concrete bridges, viaducts, etc., with Leo Traugott, Louis Traugott and A. Joseph as directors.

A. R. Hance, for six years in the sales department of the Bucyrus Co., in the Central and Eastern territories, has been appointed Northwestern sales manager for that company with offices in Portland, Ore.

The Chicago address of the Barber-Greene Co. has been changed from 11 S. La Salle Street to 9 S. Clinton Street.

PUBLIC SAFETY HEARINGS

The California Industrial Accident Commission announces four Public Safety Hearings to consider a General Safety Order for the operation of hoists and elevators on construction work and the re-adoption of Trench Construction Safety Orders.